General

Guideline Title

American Association of Clinical Endocrinologists' guidelines for management of dyslipidemia and prevention of atherosclerosis.

Bibliographic Source(s)

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: American Association of Clinical Endocrinologists. AACE medical guidelines for clinical practice for the diagnosis and treatment of dyslipidemia and prevention of atherogenesis. Endocr Pract 2000 Mar-Apr;6(2):162-213.

Recommendations

Major Recommendations

The levels of evidence (EL) (1 to 4) and the recommendation grades (A to D) are defined at the end of the "Major Recommendations" field.

Executive Summary of Recommendations

Clinical questions are labeled "Q." Recommendations are labeled "R," and are based on importance and evidence (Grades A, B, and C) or expert opinion when there is a lack of conclusive clinical evidence (Grade D). The best evidence level (BEL), which corresponds to the best conclusive evidence found, accompanies the recommendation grade in this summary. Reference citations include the EL numerical descriptor.

Q1. How Should Individuals Be Screened for the Detection of Dyslipidemia?

Q1.1. Global Risk Assessment

R1. Identify risk factors (see Table 5 in the original guideline document) (National Institutes of Health, 2002 [EL 4]; American Association of Clinical Endocrinologists Polycystic Ovary Syndrome Writing Committee, 2005 [EL 4]; Einhorn et al., 2003 [EL 4]; Grundy et al., 1998 [EL 4]; Yusuf et al., 2004 [EL 2]; American Diabetes Association, 2009 [EL 4]; Neaton et al., 1992 [EL 2]; National Heart, Lung, and Blood Institute, 2004 [EL 4]; Stamler, Wentworth, & Neaton, 1986 [EL 2]; Kastelein et al., 2008 [EL 2]; Brunzell et al., 2008 [EL 4]; Cromwell et al., 2007 [EL 3]) and categorize degrees of risk (see Table 6 in the original guideline document) (Brunzell et al., 2008 [EL 4]; Smith et al., 2006 [EL 4]; Grundy et al., 2004 [EL 4]), which enables the physician to personalize therapy for dyslipidemia according to each patient's risk level and thereby maximize treatment effectiveness (Grade A; BEL 1).

Major risk factors include advancing age, high serum total cholesterol levels, high non-high-density lipoprotein cholesterol (non–HDL-C) levels, high low-density lipoprotein cholesterol (LDL-C) levels, established coronary artery disease (CAD), family history of CAD, presence of hypertension or diabetes mellitus, and cigarette smoking. Additional risk factors (obesity, family history, elevated apo B, increased low-density lipoprotein (LDL) particle number, small dense LDL, fasting/postprandial hypertriglyceridemia, polycystic ovary syndrome in women, dyslipidemic triad) should be considered, as should nontraditional risk factors (e.g., inflammatory markers, highly sensitive C-reactive protein [CRP], lipoprotein-associated phospholipase A_2 [Lp-PLA$_2$]; lipoprotein [a], hyperhomocysteinemia, hyperuricemia).

R2. Determine the 10-year risk (high, intermediate, low) of a coronary event using the Framingham Risk Assessment Tool or Reynolds Risk Score (www.reynoldsriskscore.org⬚), (the latter includes highly sensitive CRP and family history of premature CAD) (Grade A; BEL 4).

R3. Because of the diagnostic difficulties and differences in clinical presentation, the American Association of Clinical Endocrinologists (AACE) recommends that special attention be given to assessing women for CAD risk. Determine the 10-year risk (high, intermediate, low) of a coronary event using Reynolds Risk Score (www.reynoldsriskscore.org⬚) or the Framingham Risk Assessment Tool (Grade A; BEL 4). The Framingham Risk Score provides 10-year probability of women experiencing a coronary event in the presence of specific clinical diagnoses or scenarios (see Table 7 in the original guideline document) (Lloyd-Jones et al., 2004 [EL 3]; Mosca et al., 2004 [EL 4]), but unlike the Reynolds Risk Score, it appears to underestimate CAD risk in women with two risk factors.

R4. AACE recommends early diagnosis and management of pediatric dyslipidemia to reduce the levels of LDL-C that may eventually increase risk of cardiovascular events in adulthood (Grade A; BEL 1). Classification of LDL-C levels as acceptable, borderline, or high is outlined in Table 8 in the original guideline document (American Academy of Pediatrics, 1992 [EL 4]).

R5. Categorize lipid-related risks as optimal/near-optimal, borderline, and high risk (see Table 9 in the original guideline document) (National Institutes of Health, 2002 [EL 4]). An HDL-C concentration greater than 60 mg/dL is an independent negative risk factor in both sexes, and when the HDL-C concentration is greater than 60 mg/dL, one risk factor can be subtracted from a patient's overall risk profile (Grade A; BEL 1).

R6. AACE recommends classifying elevated triglycerides (see Table 10 in the original guideline document) (National Institutes of Health, 2002 [EL 4]) to aid in treatment decisions (Grade A; BEL 1).

Q1.2. Screening

R7. AACE recommends more frequent assessments for all patients with a family history of premature CAD (definite myocardial infarction [MI] or sudden death before age 55 years in father or other male first-degree relative, or before age 65 years in mother or other female first-degree relative) (Grade C; BEL 4). AACE suggest considering more frequent testing for individuals with CAD risk factors (Grade C; BEL 4).

Adults with Diabetes

R8. Annually screen all adult patients with diabetes mellitus for dyslipidemia (Grade B; BEL 2).

Young Adults (Men Aged 20-45 Years, Women Aged 20-55 Years)

R9. Evaluate all adults 20 years of age for dyslipidemia every 5 years as part of a global risk assessment (Grade A; BEL 3).

Middle-Aged Adults (Men Aged 45-65 Years, Women Aged 55-65 Years)

R10. In the absence of CAD risk factors, screen middle-aged persons for dyslipidemia at least every 1 to 2 years. AACE recommends more frequent lipid testing when multiple *global CAD risk factors* are present (Grade C; BEL 3). The frequency of testing should be based on individual clinical circumstances and the clinician's best judgment (Grade C; BEL 4).

Older Adults (Older Than 65 Years)

R11. Annually screen older adults with 0 to 1 CAD risk factor for dyslipidemia (Grade C; BEL 1). In addition, older patients should undergo lipid assessment if they have multiple CAD global risk factors (i.e., risk factors other than age) (Grade C; BEL 4).

R12. AACE believes that screening recommendations apply based on age and risk, not based on sex; therefore, women should be screened in the same way as men (Grade A; BEL 1).

Children and Adolescents

R13. Screen children older than 2 years every 3 to 5 years if they have CAD risk factors or a family history of premature CAD or dyslipidemia, are overweight or obese, have other elements of the insulin resistance syndrome, or have no available family history (Grade A; BEL 4).

R14. Screen adolescents older than 16 years every 5 years or more frequently if they have CAD risk factors, are overweight or obese, have other elements of the insulin resistance syndrome, or have a family history of premature CAD (Grade A; BEL 3).

AACE joins the American Heart Association and the US Preventive Services Task Force in recommending further research to determine the effect of pediatric dyslipidemia screening and treatment on adult outcomes (McCrindle et al., 2007 [EL 4]; US Preventive Services Task Force, 2007 [EL 4]).

Q2. Which Screening Tests Are Recommended for the Detection of Cardiovascular Risk?

Q2.1. Fasting Lipid Profile

R15. Use a fasting lipid profile to ensure the most precise lipid assessment. This should include total cholesterol, LDL-C, triglycerides, and high density lipoprotein-C (HDL-C) (Grade C; BEL 4).

Q2.2. Low-Density Lipoprotein Cholesterol

Calculated

R16. AACE does not recommend estimating LDL-C values in certain clinical circumstances. LDL-C is frequently and inexpensively estimated using the Friedewald equation: (Grade A, BEL 1) (National Institutes of Health, 2002 [EL 4]):

LDL-C = (total cholesterol – HDL-C) – triglycerides/5

However, this method is valid only for values obtained during the fasting state. It becomes increasingly inaccurate when triglyceride levels are greater than 200 mg/dL, and the equation is no longer valid when triglyceride levels are greater than 400 mg/dL.

Direct Measurement

R17. AACE recommends direct measurement of LDL-C in certain high-risk patients, such as those with fasting triglyceride levels greater than 250 mg/dL or those with diabetes mellitus or known vascular disease (Grade C; BEL 3).

Q2.3. HDL-Cholesterol

R18. AACE recommends measurement of HDL-C as a screening test for dyslipidemia. Low HDL-C can act synergistically with other lipid risk factors to increase CAD risk. An HDL-C concentration greater than 60 mg/dL is an independent negative risk factor in both sexes.

Q2.4. Non–HDL-C

R19. Calculate non–HDL-C (total cholesterol minus HDL-C) in patients with moderately elevated triglycerides (200 to 500 mg/dL), diabetes mellitus, and/or established CAD (Grade C; BEL 2).

R20. If insulin resistance is suspected, AACE recommends evaluating non–HDL-C to gain useful information regarding the patient's total atherogenic lipoprotein burden. In addition, in any circumstance when triglycerides are 200 mg/dL or greater but less than 500 mg/dL, a non–HDL-C calculation will provide better risk assessment than LDL-C alone (Grade C; BEL 4). Non–HDL-C targets are 30 mg/dL higher than established LDL-C risk levels (Grade C; BEL 4).

Q2.5. Triglycerides

R21. Increasing clinical evidence suggests that elevated triglycerides may be an independent risk factor for CAD; therefore, AACE recommends screening of triglycerides as a component of lipid screening. Triglycerides levels that are even moderately elevated (>150 mg/dL) may identify individuals at risk for the insulin resistance syndrome. Triglyceride levels 200 mg/dL or greater may indicate a substantial increase in CAD risk (National Institutes of Health, 2002 [EL 4]).

Q2.6. Apolipoproteins

R22. AACE recommends that optimal apo B levels for patients at risk of CAD, including those with diabetes, are less than 90 mg/dL, while patients with established CAD or diabetes who have one or more additional risk factor(s) should have an apo B goal of less than 80 mg/dL (Grade D; BEL 4). When the triglyceride level is greater than 150 mg/dL or the HDL-C level is less than 40 mg/dL, AACE believes that the apo B or the apo B to apo AI ratio may be particularly useful in assessing residual risk in patients at risk for CAD (even when LDL-C levels are controlled); this includes patients with established CAD, type 2 diabetes, or the insulin resistance syndrome who are at high risk for CAD. AACE therefore recommends apo B testing in such patients (Grade B; BEL 2).

R23. AACE recommends apo B measurements to assess the success of LDL-C–lowering therapy. Apo B reflects LDL particle number, which may be elevated in patients at or below LDL-C goal. While LDL-C and LDL particle *size* (e.g., small, dense LDL) are associated with atherogenicity, LDL particle *number* as reflected by apo B is a more potent measure of cardiovascular disease (CVD) risk than either of these two measures (Grade B; BEL 2).

R24. AACE believes that assessment of apo AI may be useful in certain cases (Grade B; BEL 2). A normal apo AI level in a patient with low HDL-C suggests the existence of an adequate number of HDL-C particles that contain less cholesterol and may be an indication of less risk. The INTERHEART study found that the apo B to apo AI ratio was among the most significant risk factors for MI (Yusuf et al., 2004 [EL 2]).

Q2.7. Secondary Causes of Dyslipidemia

R25. Rule out secondary causes of dyslipidemia. Numerous conditions may variably affect total cholesterol and LDL-C or triglycerides and very low-density lipoprotein cholesterol (VLDL-C) (see Table 11 in the original guideline document) (National Institutes of Health, 2002 [EL 4]; AACE Diabetes Mellitus Clinical Practice Guidelines Task Force, 2007 [EL 4]).

Q2.8. Additional Tests

R26. Assess markers of inflammation in patients where further stratification of risk is necessary. Highly sensitive CRP and Lp-PLA$_2$ provide useful additional information in these instances and appear to be synergistic in predicting risk of CVD and stroke (Grade B; BEL 1).

R27. Use highly sensitive CRP to stratify CVD risk in patients with a standard risk assessment that is borderline, or in those with an LDL-C concentration less than 130 mg/dL (Grade 2; BEL B).

R28. Measure Lp-PLA$_2$, which in some studies has demonstrated more specificity than highly sensitive CRP, when it is necessary to further stratify a patient's CVD risk, especially in the presence of systemic highly sensitive CRP elevations (Grade 2; BEL B).

R29. AACE does not recommend routine measurement of homocysteine, uric acid, plasminogen activator inhibitor 1, or other inflammatory markers because the benefit of doing so is unclear (Grade 4; BEL D). Although recent data from the third National Health and Nutrition Examination Survey (Park et al., 2010 [EL 3]) and MESA (Multi-Ethnic Study of Atherosclerosis) (Veeranna et al., 2011 [EL 3]) have shown that the addition of homocysteine is useful in CVD risk stratification, especially when used in conjunction with the Framingham Risk Score, to identify patients at high CVD risk who might otherwise be classified as intermediate risk, several studies have demonstrated no benefit from intervention (U.S. Department of Health and Human Services, 2008 [EL 4]; Bonaa et al., 2006 [EL 1]; Lonn et al., 2006 [EL 1]; Ray et al., 2007 [EL 2]; Toole et al., 2004 [EL 1]).

R30. Noninvasive measures of atherosclerosis such as carotid intima media thickness (IMT) and coronary artery calcification should not be performed routinely, but may be used in certain clinical situations as adjuncts to standard CVD risk factors in an attempt to refine risk stratification and the need for more aggressive preventive strategies. Although coronary calcium correlates strongly with coronary atherosclerosis, there is a lack of definite evidence that this risk factor independently predicts coronary events (Grade 4; BEL D).

Q3. What Are the Treatment Recommendations in Patients with Dyslipidemia and CAD Risk?

Q3.1. Treatment Goals

Table 12 in the original guideline document summarizes the AACE recommended treatment goals for major lipid parameters in patients *at risk for CAD* (Brunzell et al., 2008 [EL 4]; Heart Protection Study Collaborative Group, 2002 [EL 1]; Shepherd et al., 2002 [EL 1]; Sever et al., 2003 [EL 1]; Ridker et al., 2005 [EL 1]; Barter et al., 2006 [EL 4]). However, lipid goals for all patients should be personalized by levels of risk (Brunzell et al., 2008 [EL 4]; Smith et al., 2006 [EL 4]; Grundy et al., 2004 [EL 4]).

Q3.1.1. LDL-Cholesterol

R31. In adults of both sexes, AACE recommends a target LDL-C concentration less than 100 mg/dL and less than 70 mg/dL in *all* patients at very high risk (Grade A; BEL 4). For patients with diabetes mellitus, AACE recommends an LDL-C goal of less than 100 mg/dL, and in those with one or more additional risk factor(s) (e.g., existing CVD), the recommended LDL-C goal is less than 70 mg/dL (Grade A; BEL 1) (see Table 12 in the original guideline document) (Brunzell et al., 2008 [EL 4]; Heart Protection Study Collaborative Group, 2002 [EL 1]; Shepherd et al., 2002 [EL 1]; Sever et al., 2003 [EL 1]; Ridker et al., 2005 [EL1]; Barter et al., 2006 [EL 4]).

R32. AACE concurs with the American Academy of Pediatrics that acceptable, borderline, and high LDL-C levels for children and adolescents are less than 110 mg/dL, 110 to 129 mg/dL, and 130 mg/dL or greater, respectively (see Table 8 in the original guideline document) (American Academy of Pediatrics, 1992 [EL 4]).

Q3.1.2. HDL-C

R33. AACE recommends raising HDL-C levels as much as possible, but *minimally* to greater than 40 mg/dL in both men and women (Grade C; BEL 4) (see Table 12 in the original guideline document) (Brunzell et al., 2008 [EL 4]; Heart Protection Study Collaborative Group, 2002 [EL 1]; Shepherd et al., 2002 [EL 1]; Sever et al., 2003 [EL 1]; Ridker et al., 2005 [EL1]; Barter et al., 2006 [EL 4]). Table 13 in the original guideline document (National Institutes of Health, 2002 [EL 4]) summarizes the basic treatment approach to isolated low HDL-C.

R34. Exclude secondary causes (e.g., cigarette smoking, certain drugs, genetic factors) of isolated low HDL-C. AACE then recommends pharmacologic intervention if HDL-C levels are low and other risk factors are present (including borderline elevated LDL-C levels, a family history of premature CAD, or a personal history of CAD) (Grade A; BEL 1) (see Table 11 in the original guideline document) (National Institutes of Health, 2002 [EL 4]). AACE does not recommend increasing HDL-C levels alone (i.e., low HDL-C without any accompanying risk factors) because it is difficult to determine from clinical trials whether increasing HDL-C levels alone is clinically beneficial.

Q3.1.3. Non–HDL-C

R35. AACE recommends a non–HDL-C goal (total cholesterol minus HDL-C) that is 30 mg/dL higher than the patient-specific LDL-C goal (Grade A, BEL 1) (see Table 12 in the original guideline document) (Brunzell et al., 2008 [EL 4]; Heart Protection Study Collaborative Group, 2002 [EL 1]; Shepherd et al., 2002 [EL 1]; Sever et al., 2003 [EL 1]; Ridker et al., 2005 [EL1]; Barter et al., 2006 [EL 4]).

Q3.1.4. Apolipoproteins

R36. AACE recommends that an optimal apo B level for patients at risk of CAD, including those with diabetes, is less than 90 mg/dL, while patients with established CAD or diabetes plus one or more additional risk factor(s) should have an apo B goal less than 80 mg/dL (Grade D, BEL 4) (see Table 12 in the original guideline document) (Brunzell et al., 2008 [EL 4]; Heart Protection Study Collaborative Group, 2002 [EL 1]; Shepherd et al., 2002 [EL 1]; Sever et al., 2003 [EL 1]; Ridker et al., 2005 [EL1]; Barter et al., 2006 [EL 4]).

Q3.1.5 Triglycerides

R37. Triglyceride levels less than 150 mg/dL in both men and women are recommended (Grade A; BEL 4) (see Table 12 in the original guideline document) (Brunzell et al., 2008 [EL 4]; Heart Protection Study Collaborative Group, 2002 [EL 1]; Shepherd et al., 2002 [EL 1]; Sever et al., 2003 [EL 1]; Ridker et al., 2005 [EL1]; Barter et al., 2006 [EL 4]). There is increased atherogenicity of LDL particles at increasing triglyceride levels, which correlate with risk.

Q3.2. Treatment Recommendations

R38. AACE recommends a comprehensive strategy to control lipid levels and to address associated metabolic abnormalities and modifiable risk factors such as hypertension, diabetes, obesity, and cigarette smoking. The first-line approach to primary prevention in patients with lipid disorders involves the implementation of lifestyle changes, including physical activity and medical nutrition therapy. Treatment may also involve pharmacotherapy, as well as patient education programs, to promote further risk reduction through smoking cessation and weight loss.

Q3.2.1. Physical Activity

R39. AACE recommends a reasonable and feasible approach to fitness therapy (i.e., exercise programs that include at least 30 minutes of moderate-intensity physical activity [consuming 4-7 kcal/min] 4 to 6 times weekly, with an expenditure of at least 200 kcal/day). Suggested activities include brisk walking, riding a stationary bike, water aerobics, cleaning/scrubbing, mowing the lawn, and sporting activities (Grade A; BEL 2). Daily physical activity goals can be met in a single session or in multiple sessions throughout the course of a day (10 minutes minimum). For some patients, breaking activity up throughout the day may help improve adherence to physical activity programs (Grade B; BEL 4). In addition to aerobic activity, muscle-strengthening activity is recommended at least two days a week (Grade B; BEL 2).

Q3.2.2. Medical Nutrition Therapy

R40. For adults, AACE recommends a reduced-calorie diet consisting of fruits and vegetables (≥5 servings/day) (Grade A; BEL 2), grains (≥6 servings/day, one-third of those as whole grains), fish, and lean meats (Grade B; BEL 2). Intake of saturated fats, trans fats, and cholesterol should be limited, while LDL-C–lowering macronutrient intake should include plant stanols/sterols (~2 g/day) and soluble fiber (10-25 g/day) (Grade A; BEL 1).

R41. AACE recommends primary preventive nutrition in all healthy children older than 2 years (Grade A; BEL 4).

Q3.2.3. Smoking Cessation

R42. Every effort should be made to support patients in their efforts to cease smoking (Grade A; BEL 3). Cigarette smoking is a powerful risk

factor, especially for MI, peripheral vascular disease, and stroke. Smoking accelerates coronary plaque development and may lead to plaque rupture and is particularly dangerous in persons with advanced coronary atherosclerosis. Numerous studies have shown that smoking has a substantial, negative effect on HDL-C levels and the LDL-C to HDL-C ratio. Smoking also appears to have a negative effect on postprandial lipids, including triglycerides. However, smoking cessation significantly increases HDL-C, with improvement observed in as few as 30 days.

Q3.2.4. Pharmacologic Therapy

R43. AACE recommends aggressive lipid-modifying therapy to lower LDL-C to less than 100 mg/dL in patients with average or elevated LDL-C. This has been shown to reduce vascular mortality in patients at high risk (Grade A; BEL 1) and to decrease coronary death, MI, or any cardiovascular events in patients on aggressive statin therapy (Grade A; BEL 1). Table 14 in the original guideline document summarizes the primary lipid-lowering drug classes (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; American Diabetes Association, 2011 [EL 4]; Preiss et al., 2011 [EL 1]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; Hottelart et al., 2002 [EL 3]; Davidson et al., 2007 [EL 4]; "WelChol," 2011 [EL 4]; Zieve et al., 2007 [EL 3]; "Zetia," 2011 [EL 4]; Bays et al., 2001 [EL 1]; Dujovne et al., 2002 [EL 1]; Gagne et al., 2002 [EL 1]; Knopp et al., 2003 [EL 1]; Bays et al., 2004 [EL 1]; Bissonnette et al., 2006 [EL 3]; Brohet et al., 2005 [EL 1]; Denke et al., 2006 [EL 1]; McKenney et al. 2006 [EL 1]; Farnie, et al., 2005 [EL 1]; Aguilar-Salinas et al., 2001 [EL 2]; Guyton et al., 2000 [EL 1]; Insua et al., 2002 [EL 2]; Durrington et al., 1998 [EL 1]; Kockx et al., 1997 [EL 2]; Bröijersén et al., "Gemfibrozil reduces," 1996 [EL 2]; Athyros et al., 1995 [EL 2]; Avellone et al., 1995 [EL 1]; Bröijersén et al., "Gemfibrozil treatment," 1996 [EL 2]; Syvänne et al., 2004 [EL 1]; Westphal, Dierkes, & Luley, 2001 [EL 3]), and Table 15 in the original guideline document summarizes initial dosage recommendations (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; "WelChol," 2011 [EL 4]; "Zetia," 2011 [EL 4]; "Colestid," 2006 [EL 4]; "Niaspan," 2007 [EL 4]; "Pravachol," 2011 [EL 4]; "Livalo," 2011 [EL 4]).

R44. AACE recommends an LDL-C goal less than 70 mg/dL as an appropriate goal for *all* patients with established CAD. Current evidence indicates that LDL-C can be aggressively lowered with statin therapy regardless of baseline levels and suggests that there is no threshold below which LDL-C lowering ceases to be effective (Grade A; BEL 1). Reducing lipids to levels even below recommended targets may be beneficial for certain patients (e.g., those with metabolic syndrome). Consequently, in 2004, the National Cholesterol Education Program (NCEP) Adult Treatment Program (ATP) III updated its guidelines to include an "optional" LDL-C goal less than 70 mg/dL for patients at very high risk. *The 2004 NCEP ATP III update further indicated that it is always prudent to initiate therapy at a level sufficient to achieve a 30% to 40% LDL-C reduction* (Grundy et al., 2004 [EL 4]). The American Heart Association/American College of Cardiology 2006 update of its CVD secondary prevention guidelines also considers reduction of LDL-C to less than 70 mg/dL for patients with established CAD a "reasonable goal."

Patients for whom AACE recommends aggressive therapy:

- Patients undergoing coronary artery bypass graft (Grade A; BEL 1)
- Patients with acute coronary syndrome (Grade A; BEL 1)
- Certain healthy and functional older patients at high risk who may be appropriate candidates for aggressive therapy (Grade A; BEL 1)

Statins

R45. AACE recommends statins as the drug of choice for LDL-C reduction on the basis of findings from morbidity and mortality outcome trials (Grade A; BEL 1). Agents currently available are atorvastatin, fluvastatin, lovastatin, pravastatin, rosuvastatin, simvastatin, and pitavastatin; see Table 14 in the original guideline document (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; American Diabetes Association, 2011 [EL 4]; Preiss et al., 2011 [EL 1]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; Hottelart et al., 2002 [EL 3]; Davidson et al., 2007 [EL 4]; "WelChol," 2011 [EL 4]; Zieve et al., 2007 [EL 3]; "Zetia," 2011 [EL 4]; Bays et al., 2001 [EL 1]; Dujovne et al., 2002 [EL 1]; Gagne et al., 2002 [EL 1]; Knopp et al., 2003 [EL 1]; Bays et al., 2004 [EL 1]; Bissonnette et al., 2006 [EL 3]; Brohet et al., 2005 [EL 1]; Denke et al., 2006 [EL 1]; McKenney et al. 2006 [EL 1]; Farnie, et al., 2005 [EL 1]; Aguilar-Salinas et al., 2001 [EL 2]; Guyton et al., 2000 [EL 1]; Insua et al., 2002 [EL 2]; Durrington et al., 1998 [EL 1]; Kockx et al., 1997 [EL 2]; Bröijersén et al., "Gemfibrozil reduces," 1996 [EL 2]; Athyros et al., 1995 [EL 2]; Avellone et al., 1995 [EL 1]; Bröijersén et al., "Gemfibrozil treatment," 1996 [EL 2]; Syvänne et al., 2004 [EL 1]; Westphal, Dierkes, & Luley, 2001 [EL 3]), and Table 15 in the original guideline document summarizes initial dosage recommendations (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; "WelChol," 2011 [EL 4]; "Zetia," 2011 [EL 4]; "Colestid," 2006 [EL 4]; "Niaspan," 2007 [EL 4]; "Pravachol," 2011 [EL 4]; "Livalo," 2011 [EL 4]).

Fibrates

R46. AACE recommends fibrates for treatment of severe hypertriglyceridemia (triglycerides >500 mg/dL) (Grade A; BEL 1). Adjunct use of 2 to 4 g of omega 3 fish oil can be used, if necessary, to achieve satisfactory triglyceride lowering.

For *primary prevention* of ischemic cardiovascular events, fibrate therapy can reduce the occurrence of MI and cardiovascular death in those with both triglyceride concentrations greater than 200 mg/dL and HDL-C concentrations less than 40 mg/dL (Keech et al., 2005 [EL 3]; Tenkanen et al., 2006 [EL 2]).

For *secondary prevention*, fibrate monotherapy was shown to reduce events in those with HDL-C concentrations less than 40 mg/dL in the VA-HIT trial (Veterans Affairs HDL Intervention Trial) (Robins et al., 2001 [EL 1]) and in those with triglyceride concentrations of 200 mg/dL or greater in the Bezafibrate Infarction Prevention trial ("Secondary prevention," 2000 [EL 1]). The FIELD (Fenofibrate Intervention and Event Lowering in Diabetes) trial demonstrated a more certain preventive effect in patients with both triglyceride levels greater than 200 mg/dL and HDL-C levels less than 40 mg/dL (Keech et al., 2005 [EL 3]).

In those on a statin with an LDL-C concentration less than 100 mg/dL, prespecified subgroup analyses in the ACCORD trial (Action to Control Cardiovascular Risk in Diabetes) demonstrate that fibrate therapy reduces further cardiovascular ischemic events only in those with both lipid abnormalities (triglycerides ≥200 mg/dL, HDL-C ≤35 mg/dL) (ACCORD Study Group et al., 2010 [EL 1]). The failure to reach primary endpoint targets of MI and cardiovascular death in the FIELD and ACCORD trials has resulted in an uncertain clinical benefit in treating patients with lesser triglyceride and HDL-C abnormalities with fibrates. Available agents are gemfibrozil, fenofibrate, and fenofibric acid; see Table 14 in the original guideline document (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; American Diabetes Association, 2011 [EL 4]; Preiss et al., 2011 [EL 1]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; Hottelart et al., 2002 [EL 3]; Davidson et al., 2007 [EL 4]; "WelChol," 2011 [EL 4]; Zieve et al., 2007 [EL 3]; "Zetia," 2011 [EL 4]; Bays et al., 2001 [EL 1]; Dujovne et al., 2002 [EL 1]; Gagne et al., 2002 [EL 1]; Knopp et al., 2003 [EL 1]; Bays et al., 2004 [EL 1]; Bissonnette et al., 2006 [EL 3]; Brohet et al., 2005 [EL 1]; Denke et al., 2006 [EL 1]; McKenney et al. 2006 [EL 1]; Farnie, et al., 2005 [EL 1]; Aguilar-Salinas et al., 2001 [EL 2]; Guyton et al., 2000 [EL 1]; Insua et al., 2002 [EL 2]; Durrington et al., 1998 [EL 1]; Kockx et al., 1997 [EL 2]; Bröijersén et al., "Gemfibrozil reduces," 1996 [EL 2]; Athyros et al., 1995 [EL 2]; Avellone et al., 1995 [EL 1]; Bröijersén et al., "Gemfibrozil treatment," 1996 [EL 2]; Syvänne et al., 2004 [EL 1]; Westphal, Dierkes, & Luley, 2001 [EL 3]), and Table 15 in the original guideline document summarizes initial dosage recommendations (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; "WelChol," 2011 [EL 4]; "Zetia," 2011 [EL 4]; "Colestid," 2006 [EL 4]; "Niaspan," 2007 [EL 4]; "Pravachol," 2011 [EL 4]; "Livalo," 2011 [EL 4]).

Niacin

R47. AACE recommends niacin for reducing triglycerides, increasing HDL-C, and reducing LDL-C (Grade B; BEL 2). Adjunct use of 2 to 4 g of omega-3 fish oil can be used, if necessary, to achieve satisfactory triglyceride lowering. In contrast to the existing secondary cardiovascular preventive evidence from the Coronary Drug Project (Canner et al., 1986 [EL 2]), HATS (HDL-Atherosclerosis Treatment Study) (Vittone et al., 2007 [EL 1]), and ARBITER 6–HALTS (Arterial Biology for the Investigation of the Treatment Effects of Reducing Cholesterol 6: HDL and LDL Treatment Strategies in Atherosclerosis) (Villines et al., 2010 [EL 1]) trials, cessation of the AIM-HIGH trial (Atherothrombosis Intervention in Metabolic Syndrome with Low HDL/High Triglycerides: Impact on Global Health Outcomes) (AIM-HIGH Investigators, 2011 [EL 1]) makes it uncertain whether niacin benefits all simvastatin-treated patients with very well-controlled LDL-C. Niacin is currently available in three formulations: intermediate, long-acting, and extended-release; see Table 14 in the original guideline document (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; American Diabetes Association, 2011 [EL 4]; Preiss et al., 2011 [EL 1]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; Hottelart et al., 2002 [EL 3]; Davidson et al., 2007 [EL 4]; "WelChol," 2011 [EL 4]; Zieve et al., 2007 [EL 3]; "Zetia," 2011 [EL 4]; Bays et al., 2001 [EL 1]; Dujovne et al., 2002 [EL 1]; Gagne et al., 2002 [EL 1]; Knopp et al., 2003 [EL 1]; Bays et al., 2004 [EL 1]; Bissonnette et al., 2006 [EL 3]; Brohet et al., 2005 [EL 1]; Denke et al., 2006 [EL 1]; McKenney et al. 2006 [EL 1]; Farnie, et al., 2005 [EL 1]; Aguilar-Salinas et al., 2001 [EL 2]; Guyton et al., 2000 [EL 1]; Insua et al., 2002 [EL 2]; Durrington et al., 1998 [EL 1]; Kockx et al., 1997 [EL 2]; Bröijersén et al., "Gemfibrozil reduces," 1996 [EL 2]; Athyros et al., 1995 [EL 2]; Avellone et al., 1995 [EL 1]; Bröijersén et al., "Gemfibrozil treatment," 1996 [EL 2]; Syvänne et al., 2004 [EL 1]; Westphal, Dierkes, & Luley, 2001 [EL 3]), and Table 15 in the original guideline document summarizes initial dosage recommendations (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; "WelChol," 2011 [EL 4]; "Zetia," 2011 [EL 4]; "Colestid," 2006 [EL 4]; "Niaspan," 2007 [EL 4]; "Pravachol," 2011 [EL 4]; "Livalo," 2011 [EL 4]).

Bile Acid Sequestrants

R48. AACE recommends bile acid sequestrants for reducing LDL-C and apo B and modestly increasing HDL-C, but they may increase

triglycerides (Grade B; BEL 1). Bile acid sequestrants have a glucose-lowering effect; colesevelam is now also approved for treatment of type 2 diabetes. Available agents in this drug class are cholestyramine, colestipol, and colesevelam; see Table 14 in the original guideline document (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; American Diabetes Association, 2011 [EL 4]; Preiss et al., 2011 [EL 1]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; Hottelart et al., 2002 [EL 3]; Davidson et al., 2007 [EL 4]; "WelChol," 2011 [EL 4]; Zieve et al., 2007 [EL 3]; "Zetia," 2011 [EL 4]; Bays et al., 2001 [EL 1]; Dujovne et al., 2002 [EL 1]; Gagne et al., 2002 [EL 1]; Knopp et al., 2003 [EL 1]; Bays et al., 2004 [EL 1]; Bissonnette et al., 2006 [EL 3]; Brohet et al., 2005 [EL 1]; Denke et al., 2006 [EL 1]; McKenney et al. 2006 [EL 1]; Farnie, et al., 2005 [EL 1]; Aguilar-Salinas et al., 2001 [EL 2]; Guyton et al., 2000 [EL 1]; Insua et al., 2002 [EL 2]; Durrington et al., 1998 [EL 1]; Kockx et al., 1997 [EL 2]; Bröijersén et al., "Gemfibrozil reduces," 1996 [EL 2]; Athyros et al., 1995 [EL 2]; Avellone et al., 1995 [EL 1]; Bröijersén et al., "Gemfibrozil treatment," 1996 [EL 2]; Syvänne et al., 2004 [EL 1]; Westphal, Dierkes, & Luley, 2001 [EL 3]), and Table 15 in the original guideline document summarizes initial dosage recommendations (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; "WelChol," 2011 [EL 4]; "Zetia," 2011 [EL 4]; "Colestid," 2006 [EL 4]; "Niaspan," 2007 [EL 4]; "Pravachol," 2011 [EL 4]; "Livalo," 2011 [EL 4]).

Cholesterol Absorption Inhibitors

R49. Cholesterol absorption inhibitors are effective as monotherapy in reducing LDL-C and apo B. AACE recommends combination therapy with statins because current research indicates that this enhances these benefits and further improves the beneficial effects of statins on triglycerides and HDL-C (Grade A; BEL 1). It is uncertain whether cholesterol absorption inhibitor therapy has a direct benefit on reducing cardiovascular events (Grade B; BEL 1). Ezetimibe is currently the only member of this drug class; see Table 14 in the original guideline document (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; American Diabetes Association, 2011 [EL 4]; Preiss et al., 2011 [EL 1]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; Hottelart et al., 2002 [EL 3]; Davidson et al., 2007 [EL 4]; "WelChol," 2011 [EL 4]; Zieve et al., 2007 [EL 3]; "Zetia," 2011 [EL 4]; Bays et al., 2001 [EL 1]; Dujovne et al., 2002 [EL 1]; Gagne et al., 2002 [EL 1]; Knopp et al., 2003 [EL 1]; Bays et al., 2004 [EL 1]; Bissonnette et al., 2006 [EL 3]; Brohet et al., 2005 [EL 1]; Denke et al., 2006 [EL 1]; McKenney et al. 2006 [EL 1]; Farnie, et al., 2005 [EL 1]; Aguilar-Salinas et al., 2001 [EL 2]; Guyton et al., 2000 [EL 1]; Insua et al., 2002 [EL 2]; Durrington et al., 1998 [EL 1]; Kockx et al., 1997 [EL 2]; Bröijersén et al., "Gemfibrozil reduces," 1996 [EL 2]; Athyros et al., 1995 [EL 2]; Avellone et al., 1995 [EL 1]; Bröijersén et al., "Gemfibrozil treatment," 1996 [EL 2]; Syvänne et al., 2004 [EL 1]; Westphal, Dierkes, & Luley, 2001 [EL 3]), and Table 15 in the original guideline document summarizes initial dosage recommendations (International Food Information Council Foundation, 2012 [EL 4]; "Mevacor," 2010 [EL 4]; "Zocor," 2011 [EL 4]; "Lescol," 2011 [EL 4]; "Crestor," 2011 [EL 4]; "Lipitor," 2009 [EL 4]; "Lopid," 2008 [EL 4]; "Tricor," 2010 [EL 4]; "Trilipix," 2008 [EL 4]; "WelChol," 2011 [EL 4]; "Zetia," 2011 [EL 4]; "Colestid," 2006 [EL 4]; "Niaspan," 2007 [EL 4]; "Pravachol," 2011 [EL 4]; "Livalo," 2011 [EL 4]).

Combination Therapy

R50. Certain clinical situations warrant the use of a combination of lipid-lowering agents. Because the adverse effects of two or more drugs may be additive, clinical judgment is needed to balance the risks and benefits of combination therapy.

AACE recommends that combination therapy be considered in the following circumstances:

- When the cholesterol level is markedly increased and monotherapy does not achieve the therapeutic goal (Grade A; BEL 1).
  - The recent SHARP trial (Study of Heart and Renal Protection) demonstrated a reduction of LDL-C via treatment with simvastatin, 20 mg daily, plus ezetimibe, 10 mg daily, which safely reduced the incidence of major atherosclerotic events in a wide range of patients with advanced chronic kidney disease (Baigent et al., 2011 [EL 1]).
- When mixed dyslipidemia is present (Grade C; BEL 3).
- Niacin or fibrates in combination with statins may be appropriate options for many patients with hypertriglyceridemia and associated low HDL-C (Grade B; BEL 2).
  - *It is uncertain whether, or in whom, niacin use in patients with very well-controlled LDL-C levels on statin therapy adds additional benefit, based on the results of the recently terminated AIM-HIGH study* (Grade A; BEL 1) (AIM-HIGH Investigators, 2011 [EL 1]). HPS2-THRIVE (Treatment of HDL to Reduce the Incidence of Vascular Events), a large international trial of high-dosage, extended-release niacin plus simvastatin (results expected in 2013), should help clarify the role of simvastatin in combination with niacin (University of Oxford, Merck, 2007 [EL 4]).
- To reduce the risk of dosage-related adverse effects (Grade D; BEL 4).

Special Considerations: Women

R51. AACE recommends that women should be identified for CAD risk and be treated with pharmacotherapy if lifestyle intervention is insufficient (Grade A; BEL 1). In light of the diagnostic challenges that present when trying to identify CAD in women, prevention and treatment of dyslipidemia is an essential consideration in this population. However, efforts to manage dyslipidemia in women have often been inadequate. While lipid-lowering treatments are used routinely for men, they are frequently underprescribed for women (LaRosa, He, & Vupputuri, 1999 [EL 1]). Furthermore, although lowering LDL-C significantly reduces CAD risk in women, the unique roles of hormonal change on cardiovascular risk, HDL-C, and triglycerides must also be addressed.

R52. AACE does *not* recommend hormone replacement therapy for the treatment of dyslipidemia in postmenopausal women (Grade A; BEL 1).

Special Considerations: Pediatric Patients

R53. AACE recommends pharmacotherapy for children and adolescents older than 8 years who do not respond sufficiently to lifestyle modification, and particularly for those satisfying the following criteria (Grade B; BEL 3):

- LDL-C ≥190 mg/dL, *or*
- LDL-C ≥160 mg/dL *and*
  - The presence of two or more cardiovascular risk factors, even after vigorous intervention, *or*
  - A family history of premature CAD (before 55 years of age) *or*,
  - Overweight, obese, or other elements of the insulin resistance syndrome

Colesevelam has been approved for patients older than 8 years. Atorvastatin, lovastatin, pravastatin, simvastatin, and rosuvastatin have been approved for the treatment of familial hypercholesterolemia in patients 10 years or older. Cholestyramine may also be used in children.

Q3.3. Follow-up and Monitoring

R54. AACE recommends reassessing patients' lipid status 6 weeks after therapy initiation and again at 6-week intervals until the treatment goal is achieved. Thereafter, AACE recommends that patients be tested at 6- to 12-month intervals. The specific interval should depend on patient adherence to therapy and lipid profile consistency. If adherence is a concern or the lipid profile is unstable, the patient will probably benefit from biannual assessment (Grade C; BEL 4).

R55. AACE recommends more frequent lipid status evaluation in the following *clinical* circumstances:

- Deterioration of diabetes control
- The use of a new drug known to affect lipid levels
- Progression of atherothrombotic disease
- Considerable weight gain
- An unexpected adverse change in any lipid parameter
- Development of a new CAD risk factor
- Convincing new clinical trial evidence or guidelines that suggest stricter lipid goals

R56. AACE recommends that a liver transaminase level be measured before and 3 months after statin or fibric acid treatment initiation, because most liver abnormalities occur within 3 months of treatment initiation. AACE recommends that this test be repeated periodically (e.g., semiannually) (Grade A; BEL 3).

R57. AACE recommends that patients taking niacin have transaminase levels measured at baseline and every 3 months thereafter for the first year, followed by periodic (e.g., semiannual) assessment (Grade A; BEL 3). AACE recommends that transaminase level assessment be repeated at these intervals whenever lipid-altering therapy is restarted, increased, changed, or combined (Grade A; BEL 3).

R58. AACE recommends assessment of creatine kinase levels whenever a patient reports clinically significant myalgias or muscle weakness (Grade A; BEL 3).

Q4. Is Treatment of Dyslipidemia and Prevention of Atherosclerosis Cost-Effective?

R59. Nonpharmacologic interventions such as dietary management and smoking cessation are the most cost-effective options available for CAD prevention (Grade A; BEL 3).

R60. When nonpharmacologic interventions fail, pharmacologic intervention is a recommended cost-effective option for primary and secondary intervention in persons at moderate to high risk (Grade A; BEL 3).

R61. Among otherwise healthy persons at lower risk, the cost-effectiveness of primary pharmacologic intervention varies on the basis of age and

sex (with this approach being least cost-effective among women at low risk) (Grade B; BEL 3).

R62. Statins have proven cost-effective in both secondary and primary prevention of CVD events in patients at moderate to high risk, or in patients at low risk whose LDL-C levels are very high (Grade A; BEL 1).

R63. Treatment with fibrates has been found cost-effective as both monotherapy and combination therapy for lowering triglycerides and raising HDL-C (Grade B; BEL 2), but not in reducing cardiovascular events except in patients with triglyceride concentrations greater than 200 mg/dL and HDL-C concentrations less than 40 mg/dL (Grade A; BEL 1).

R64. Ezetimibe coadministered with statin therapy in patients unable to meet target LDL-C levels has been identified as a cost-effective strategy to achieve LDL-C goals in studies from Canada and the United Kingdom (Grade B; BEL 2).

R65. Available pharmacoeconomic data, derived before generic availability of bile acid sequestrants, do not support the cost-effectiveness of bile acid sequestrants compared with statin therapy (Grade C; BEL 3).

R66. Limited pharmacoeconomic data support the cost-effectiveness of niacin in combination with a statin in reaching targeted lipid goals (Grade C; BEL 3).

Definitions:

2010 American Association of Clinical Endocrinologists Protocol for Production of Clinical Practice Guidelines—Step I: Evidence Rating

Numerical Descriptor (evidence level)[a]	Semantic Descriptor
1	Meta-analysis of randomized controlled trials
1	Randomized controlled trials
2	Meta-analysis of nonrandomized prospective or case-controlled trials
2	Nonrandomized controlled trial
2	Prospective cohort study
2	Retrospective case-control study
3	Cross-sectional study
3	Surveillance study (registries, surveys, epidemiologic study, retrospective chart review, mathematical modeling of database)
3	Consecutive case series
3	Single case reports
4	No evidence (theory, opinion, consensus, review, or preclinical study)

Adapted from: Mechanick et al., American Association of Clinical Endocrinologists Protocol for Standardized Production of Clinical Practice Guidelines--2010 update. Endocr Pract. 2010;16:270-83.

[a]1 = strong evidence; 2 = intermediate evidence; 3 = weak evidence; and 4 = no evidence

2010 American Association of Clinical Endocrinologists Protocol for Production of Clinical Practice Guidelines—Step III: Grading of Recommendations; How Different Evidence Levels Can Be Mapped to the Same Recommendation Grade[a]

Best Evidence Level	Subjective Factor Impact	Two-thirds Consensus	Mapping	Recommendation Grade
1	None	Yes	Direct	A
2	Positive	Yes	Adjust up	A
2	None	Yes	Direct	B
1	Negative	Yes	Adjust down	B

Best Evidence Level	Subjective Factor Impact	Two-thirds Consensus	Mapping	Recommendation Grade
3	Positive	Yes	Adjust up	B
3	None	Yes	Direct	C
2	Negative	Yes	Adjust down	C
4	Positive	Yes	Adjust up	C
4	None	Yes	Direct	D
3	Negative	Yes	Adjust down	D
1, 2, 3, 4	NA	No	Adjust down	D

Reprinted from American Association of Clinical Endocrinologists Protocol for Standardized Production of Clinical Practice Guidelines--2010 update. *Endocr Pract*. 2010;16:270-283.

[a]Starting with the left column, best evidence levels (BELs), subjective factors, and consensus map to recommendation grades in the right column. When subjective factors have little or no impact ("none"), then the BEL is directly mapped to recommendation grades. When subjective factors have a strong impact, then recommendation grades may be adjusted up ("positive" impact) or down ("negative" impact). If a two-thirds consensus cannot be reached, then the recommendation grade is D. NA, not applicable (regardless of the presence or absence of strong subjective factors, the absence of a two-thirds consensus mandates a recommendation grade D).

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

- Dyslipidemia
- Atherosclerosis

Guideline Category

Diagnosis

Evaluation

Management

Prevention

Risk Assessment

Screening

Treatment

Clinical Specialty

Cardiology

Endocrinology

Family Practice

Internal Medicine

Pediatrics

Preventive Medicine

Intended Users

Advanced Practice Nurses

Dietitians

Nurses

Physician Assistants

Physicians

Guideline Objective(s)

- To present an overview of the screening recommendations, assessment of risk, and treatment recommendations for various lipid disorders
- To give special consideration for patients with diabetes, women, and pediatric patients who have dyslipidemia
- To provide cost-effectiveness data to support treatment

Target Population

Children older than 2 years old, adolescents, and adults with or at risk for dyslipidemia or atherosclerosis

Interventions and Practices Considered

Screening/Risk Assessment

1. Global risk assessment
   - Identifying risk factors
   - Categorizing lipid-related risks
   - Classifying triglycerides
2. Screening based on age
   - Adults with diabetes
   - Young adults (men aged 20-35; women aged 20-55)
   - Middle-aged adults (men aged 45-65; women aged 55-65)
   - Older adults (over 65)
   - Children and adolescents
3. Screening tests
   - Fasting lipid profile
   - Low-density lipoprotein cholesterol (LDL-C)
   - High-density lipoprotein cholesterol (HDL-C)
   - Non-high-density lipoprotein cholesterol
   - Triglycerides
   - Apolipoproteins
   - Secondary causes of dyslipidemia
   - Additional tests (C-reactive protein [CRP], lipoprotein-associated phospholipase A_2 [Lp-PLA$_2$])
   - Noninvasive measures of atherosclerosis such as carotid intima media thickness (IMT) and coronary artery calcification (not recommended routinely)

Treatment/Management

1. Treatment goals for major lipid parameters, personalized by level of risk
2. Physical activity
3. Medical nutrition therapy
4. Smoking cessation
5. Pharmacologic therapy, including
   - Statins
   - Fibrates
   - Niacin
   - Bile acid sequestrants
   - Cholesterol absorption inhibitors
   - Combination therapy
6. Special considerations for specific populations (women, pediatric patients)
7. Follow-up and monitoring

Note: The following were considered but not recommended: routine measurement of homocysteine, uric acid, plasminogen activator inhibitor 1, or other inflammatory markers.

Major Outcomes Considered

- Coronary artery disease and atherosclerotic disease
- Dyslipidemia (pediatric, adult)
- Cholesterol level
- Vascular mortality, coronary death, myocardial infarction, or other cardiovascular events
- Cost-effectiveness

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

For the 2012 update, PubMed was searched for articles published since the last guideline in 2002 using the search terms lipids, dyslipidemia, hypercholesterolemia, practice guidelines, randomized controlled trials, meta-analyses, cost-effectiveness, risk, screening, pharmacotherapy, lifestyle, medical nutrition therapy, smoking cessation, children adolescents women pregnancy, primary prevention, secondary prevention, and imaging studies. In addition, prescribing information was consulted for specific dosing, administration, pregnancy, and other warnings. Reviews and high level references were included; opinion papers were excluded.

Number of Source Documents

Not stated

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

2010 American Association of Clinical Endocrinologists Protocol for Production of Clinical Practice Guidelines—Step I: Evidence Rating

Numerical Descriptor (evidence level)[a]	Semantic Descriptor
1	Meta-analysis of randomized controlled trials
1	Randomized controlled trials
2	Meta-analysis of nonrandomized prospective or case-controlled trials
2	Nonrandomized controlled trial
2	Prospective cohort study
2	Retrospective case-control study
3	Cross-sectional study
3	Surveillance study (registries, surveys, epidemiologic study, retrospective chart review, mathematical modeling of database)
3	Consecutive case series
3	Single case reports
4	No evidence (theory, opinion, consensus, review, or preclinical study)

Adapted from: Mechanick et al., American Association of Clinical Endocrinologists Protocol for Standardized Production of Clinical Practice Guidelines--2010 update. Endocr Pract. 2010;16:270-83.

[a]1 = strong evidence; 2 = intermediate evidence; 3 = weak evidence; and 4 = no evidence

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review

Description of the Methods Used to Analyze the Evidence

Recommendations are assigned evidence level (EL) ratings on the basis of the quality of supporting evidence:

2010 American Association of Clinical Endocrinologists Protocol for Production of Clinical Practice Guidelines—Step II: Evidence Analysis and Subjective Factors

Study Design	Data Analysis	Interpretation of Results
Premise correctness Allocation concealment (randomization) Selection bias Appropriate blinding Using surrogate endpoints (especially in "first-in-its-class" intervention) Sample size (beta error) Null hypothesis versus Bayesian statistics	Intent-to-treat Appropriate statistics	Generalizability Logical Incompleteness Validity

Reprinted from: American Association of Clinical Endocrinologists Protocol for Standardized Production of Clinical Practice Guidelines--2010 update. Endocr Pract. 2010;16:270-83.

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

This Clinical Practice Guideline (CPG) was developed in accordance with the American Association of Clinical Endocrinologists (AACE) Protocol for Standardized Production of Clinical Practice Guidelines—2010 Update.

Current AACE CPGs have a problem-oriented focus that results in a shortened production timeline, middle-range literature searching, emphasis on patient-oriented evidence that matters, greater transparency of intuitive evidence rating and qualifications, incorporation of subjective factors into evidence level to recommendation grade mapping, cascades of alternative approaches, and an expedited multilevel review mechanism. (See Figure 1 of the original guideline document for a schematic overview of the guideline development process.)

Recommendations are assigned evidence level (EL) ratings on the basis of the quality of supporting evidence (see the "Rating Scheme for the Strength of the Evidence" field) all of which have also been rated for strength (see the "Rating Scheme for the Strength of the Recommendations" field). The format of this CPG is based on specific and relevant clinical questions. All primary writers are AACE members and credentialed experts.

Clinical experts submitted contributions to specific clinical questions, which were subsequently reviewed, discussed, and integrated into the final document. Their valuable input provides the basis for the recommendation. Recommendations are based on importance and evidence (Grades A, B, and C) or expert opinion when there is a lack of conclusive clinical evidence (Grade D). The best evidence level (BEL), which corresponds to the best conclusive evidence found in the full guidelines in the original guideline document, accompanies the recommendation grade.

Comments may be appended to the recommendation grade and BEL regarding any relevant subjective factors that may have influenced the grading process. Details regarding each recommendation may be found in the corresponding section of the full guidelines in the original guideline document. Thus, the process leading to a final recommendation and grade is not rigid, but rather it incorporates a complex expert integration of objective and subjective factors meant to reflect optimal real-life clinical decision-making and to enhance patient care. Where appropriate, multiple recommendations are provided, so that the reader has management options. This document represents only a guideline. Qualifiers that may be appended to recommendations include cost-effectiveness, risk-benefit analysis, evidence gaps, alternative physician preferences (dissenting opinions), alternative recommendations ("cascades") (resource availability, cultural factors), and relevance (patient-oriented evidence that matters).

Rating Scheme for the Strength of the Recommendations

2010 American Association of Clinical Endocrinologists Protocol for Production of Clinical Practice Guidelines—Step III: Grading of Recommendations; How Different Evidence Levels Can Be Mapped to the Same Recommendation Grade[a]

Best Evidence Level	Subjective Factor Impact	Two-thirds Consensus	Mapping	Recommendation Grade
1	None	Yes	Direct	A
2	Positive	Yes	Adjust up	A
2	None	Yes	Direct	B
1	Negative	Yes	Adjust down	B
3	Positive	Yes	Adjust up	B
3	None	Yes	Direct	C
2	Negative	Yes	Adjust down	C
4	Positive	Yes	Adjust up	C
4	None	Yes	Direct	D
3	Negative	Yes	Adjust down	D
1, 2, 3, 4	NA	No	Adjust down	D

[a]Starting with the left column, best evidence levels (BELs), subjective factors, and consensus map to recommendation grades in the right column. When subjective factors have little or no impact ("none"), then the BEL is directly mapped to recommendation grades. When subjective factors have a strong impact, then recommendation grades may be adjusted up ("positive" impact) or down ("negative" impact). If a two-thirds consensus cannot be reached, then the recommendation grade is D. NA, not applicable (regardless of the presence or absence of strong subjective factors, the absence of a two-thirds consensus mandates a recommendation grade D).

Cost Analysis

See recommendation numbers 59-66 (Question 4 [Q4], "Is Treatment of Dyslipidemia and Prevention of Atherosclerosis Cost-Effective") in the "Major Recommendations" field and in Section 4 of the original guideline document for a discussion of the cost-effectiveness of recommendations.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

This Clinical Practice Guideline has been reviewed and approved by the primary writers, other invited experts, the American Association of Clinical Endocrinologists (AACE) Publications Committee, and the AACE Board of Directors before submission for peer review by *Endocrine Practice.*

Evidence Supporting the Recommendations

References Supporting the Recommendations

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Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Appropriate diagnosis, treatment, and management of dyslipidemia and prevention of atherosclerosis

Potential Harms

Because the adverse effects of two or more drugs may be additive, clinical judgment is needed to balance the risks and benefits of combination therapy for treatment of dyslipidemia.

See Table 14 in the original guideline document for additional considerations when using primary lipid-lowering drug classes, including adverse effects.

Contraindications

Contraindications

- A recent warning states that simvastatin, 80 mg daily, should not be used with amlodipine or ranolazine.
- Bile acid sequestrants should not be used in children with hypertriglyceridemia.

Qualifying Statements

Qualifying Statements

- American Association of Clinical Endocrinologists Medical Guidelines for Clinical Practice are systematically developed statements to assist health care professionals in medical decision-making for specific clinical conditions, but are in no way a substitute for a medical professional's independent judgment and should not be considered medical advice. Most of the content herein is based on literature reviews. In areas of uncertainty, professional judgment was applied.
- These guidelines are a working document that reflects the state of the field at the time of publication. Because rapid changes in this area are expected, periodic revisions are inevitable. We encourage medical professionals to use this information in conjunction with, and not as a replacement for, their best clinical judgment. The presented recommendations may not be appropriate in all situations. Any decision by practitioners to apply these guidelines must be made in light of local resources and individual patient circumstances.
- The process leading to a final recommendation and grade is not rigid, but rather it incorporates a complex expert integration of objective and subjective factors meant to reflect optimal real-life clinical decision-making and to enhance patient care. Where appropriate, multiple recommendations are provided, so that the reader has management options. This document represents only a guideline. Individual patient circumstances and presentations differ, and the ultimate clinical management is based on what is in the best interest of the individual patient, involving patient input and reasonable clinical judgment by the treating clinicians.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Living with Illness

Staying Healthy

IOM Domain

Effectiveness

Patient-centeredness

Identifying Information and Availability

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Adaptation

Not applicable: The guideline was not adapted from another source.

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Composition of Group That Authored the Guideline

Chair: Paul S. Jellinger, MD, MACE

Task Force Members: Donald A. Smith, MD, FACE; Adi E. Mehta, MD, FRCP(C), FACE; Om Ganda, MD, FACE; Yehuda Handelsman, MD, FACP, FACE; Helena W. Rodbard, MD, FACP, MACE; Mark D. Shepherd, MD, FACE; John A. Seibel, MD, MACE

Reviewers: Robert Kreisberg, MD; Ronald Goldberg, MD

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All primary writers have made disclosures regarding multiplicities of interests and have attested that they are not employed by industry.

Chair

Dr. Paul S. Jellinger reports that he has received speaker honoraria from Amylin Pharmaceuticals, Inc., Eli Lilly and Company, Merck & Co, Inc., and NovoNordisk A/S and has served on advisory boards for NovoNordisk A/S, Merck & Co, Inc., Boehringer Ingelheim, and Amylin Pharmaceuticals, Inc.

Task Force Members

Dr. Donald A. Smith reports that he has received advisory board honoraria from Abbott Laboratories.

Dr. Adi E. Mehta reports that he has served on the speakers' bureaus for Merck & Co, Inc., and Pfizer.

Dr. Om Ganda reports that he has received advisory board honoraria from Abbott Laboratories and speaker honoraria from Abbott Laboratories, AstraZeneca, Kowa Pharmaceuticals America, Inc., and GlaxoSmithKline plc.

Guideline Status

This is the current release of the guideline.

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Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) from the American Association of Clinical Endocrinologists (AACE) Web site .

Print copies: Available from the American Association of Clinical Endocrinologists (AACE), 245 Riverside Avenue, Suite 200, Jacksonville, FL 32202

Availability of Companion Documents

The following is available:

- American Association of Clinical Endocrinologists protocol for standardized production of clinical practice guidelines—2010 update. Endocrine Pract 2010;16:270-283. Electronic copies: Available in Portable Document Format (PDF) from the American Association of Clinical Endocrinologists (AACE) Web site .

Print copies: Available from the American Association of Clinical Endocrinologists (AACE), 245 Riverside Avenue, Suite 200, Jacksonville, FL 32202

Patient Resources

None available

NGC Status

This summary was completed by ECRI on May 10, 2000. The information was verified by the guideline developer on July 5, 2000. This summary

was subsequently updated on February 6, 2002 following release of the guideline developer's amended guideline in response to the withdrawal of the drug "Baycol (cerivastatin)." This NGC summary was updated by ECRI Institute on August 29, 2012.

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